

# ERTAC Tool Logic and Flowcharts



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# Abbreviations



- **UAF-Unit Availability File**
  - File that identifies the units in the universe of CAMD, as well as operational aspects of the units
  - Size, fuel type, region, online/offline dates, etc
- **GDU-Generation Deficit Unit**
  - Unit that is created by the program to meet power demands in the future year
  - User may manipulate locations by including ORIS IDs of facilities in likely locations within the Input\_Variables file.
- **BY-Base Year**
- **FY-Future Year**
- **AEO-American Electric Outlook**
- **NERC-National Energy Regulatory Commission**
- **CAMD-Clean Air Markets Division**
- **GR-Growth Rates**
- **ExGen Pool-Excess Generation Pool**
  - Power that needs to be redistributed from one unit to other units, due to capacity constraints
- **EF-Emission Factors**

# PRESENTATION OVERVIEW



- Data File Integrity
- Preprocessor Functions
  - QA & Manipulations
  - Calculations
- Projection Processor Functions
  - Generation calculations
  - GDUs defined, if needed
  - Excess power redistribution-two step process
  - Emission calculations
  - Outputs
- Post Processors
- Questions?

# PLEASE: Respect Input File Integrity



- *For reference case runs (CONUS 2.3 as example), the results of which may be used in SIP-quality CMAQ runs or other efforts that might affect multiple entities, states own the data on their facilities. Users of the tool should only make changes to data files with the express permission of the state staff in which the unit is located, and states must convey these changes to [ERTACEGU@gmail.com](mailto:ERTACEGU@gmail.com) so that the changes will be rolled into the master, updated input files with appropriate documentation.*
- *For case studies, the results of which may be used for all sorts of purposes (WOE demonstrations, QA/QC of tool results, policy evaluations, and other efforts), users may modify input files. If the user expects to provide the results of the case study to others outside his or her organization, ERTAC highly recommends that the user thoroughly document the case study using the MATS White Paper format and name all output files appropriately so that they are easily recognizable as case study products.*

# Preprocessor Functions



- Need for preprocessing
- Preprocessing allows improved projection outputs
- Basic functions:
  - Hourly CAMD data update to remove non-EGUs
  - Examine data outliers
  - Sets up BY structure
  - Examines input files

# Files Fed to Preprocessor



- **Mandatory files:**

- UAF

- ✦ 1 line per unit, generally
- ✦ Needs significant state input

- Controls File

- ✦ What emission rates change between BY and FY?
- ✦ Needs significant state input

- BY hourly CAMD data

- Growth rate file (AEO, NERC)

- Input\_variables (user flexibility)

- **Optional files:**

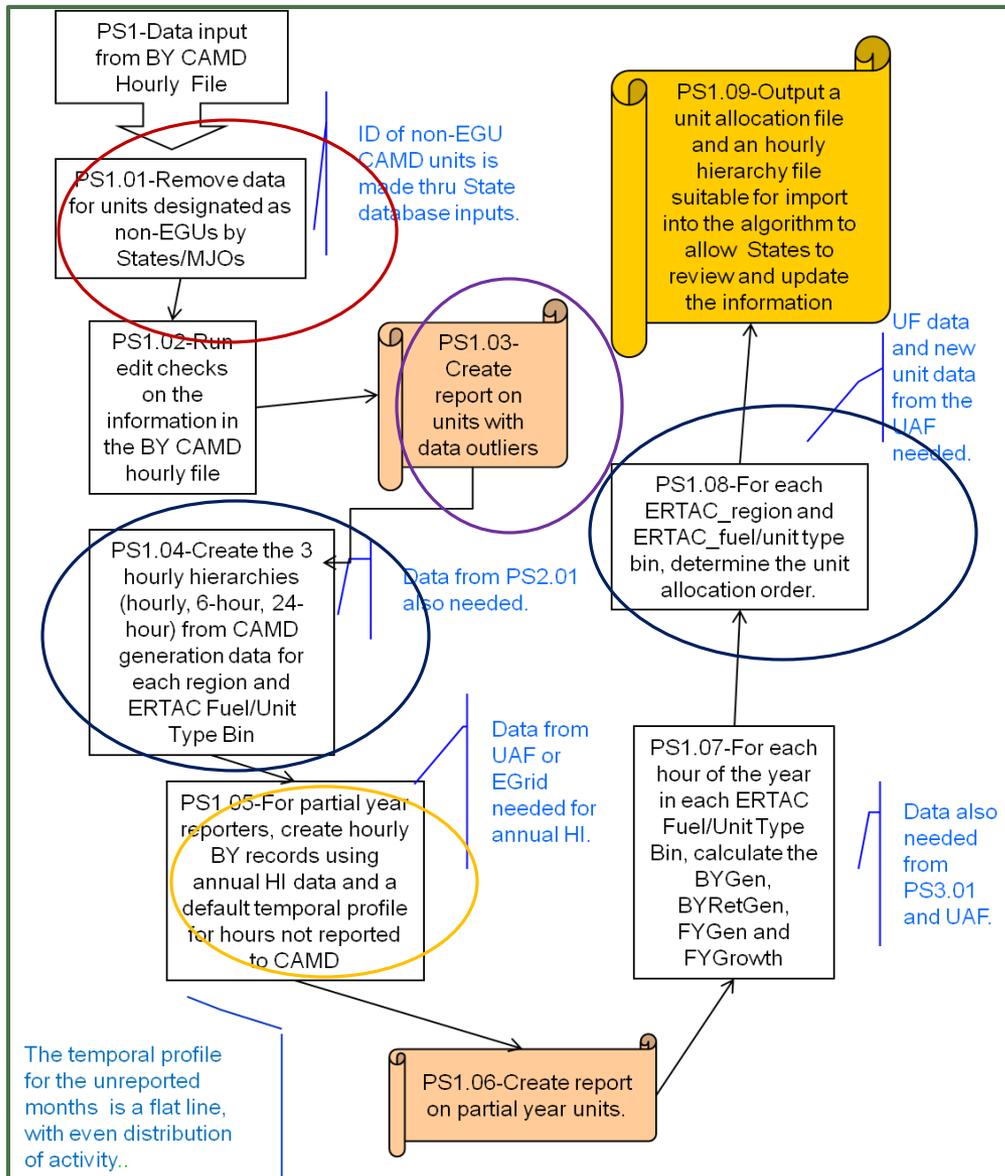
- State, Group Caps

- NonCAMD Unit File- allows additions and edits to BY hourly data

- Seasonal Emissions File

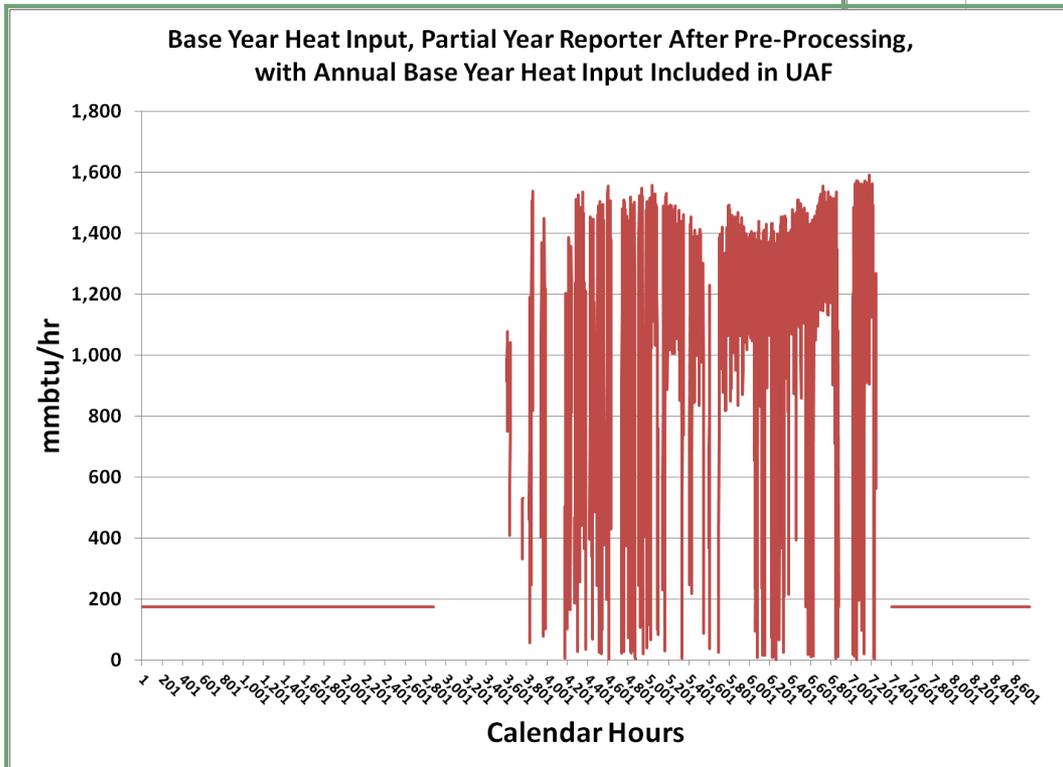
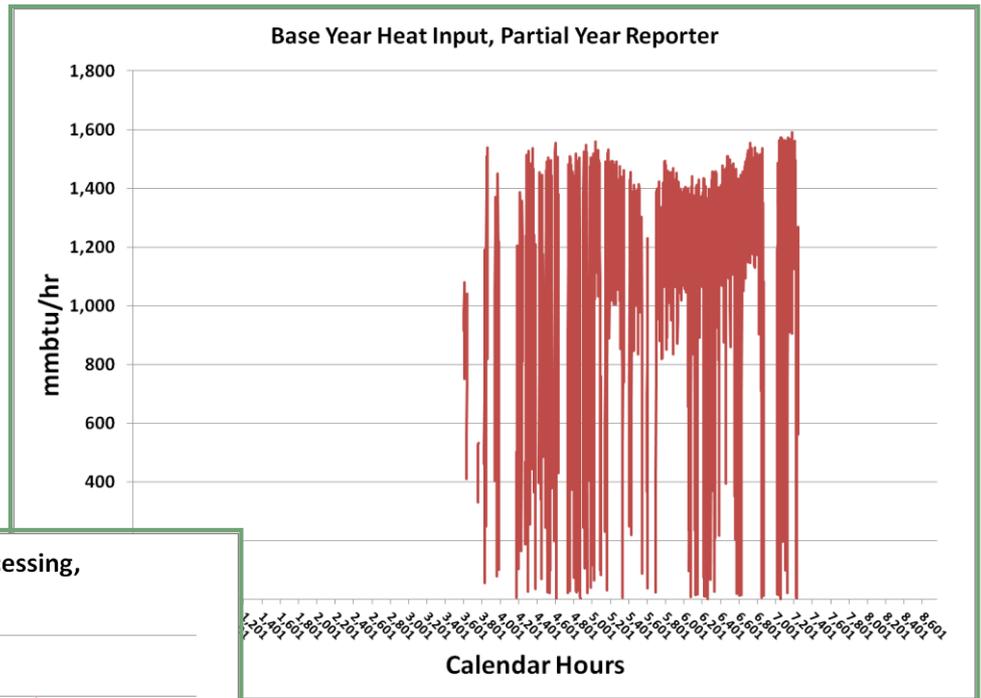
# Preprocessor, part 1

- Removes nonEGUs
- BY hourly CAMD data QA
- Hourly hierarchy
- Unit hierarchy
- Partial year reporters



# Partial Year Reporters

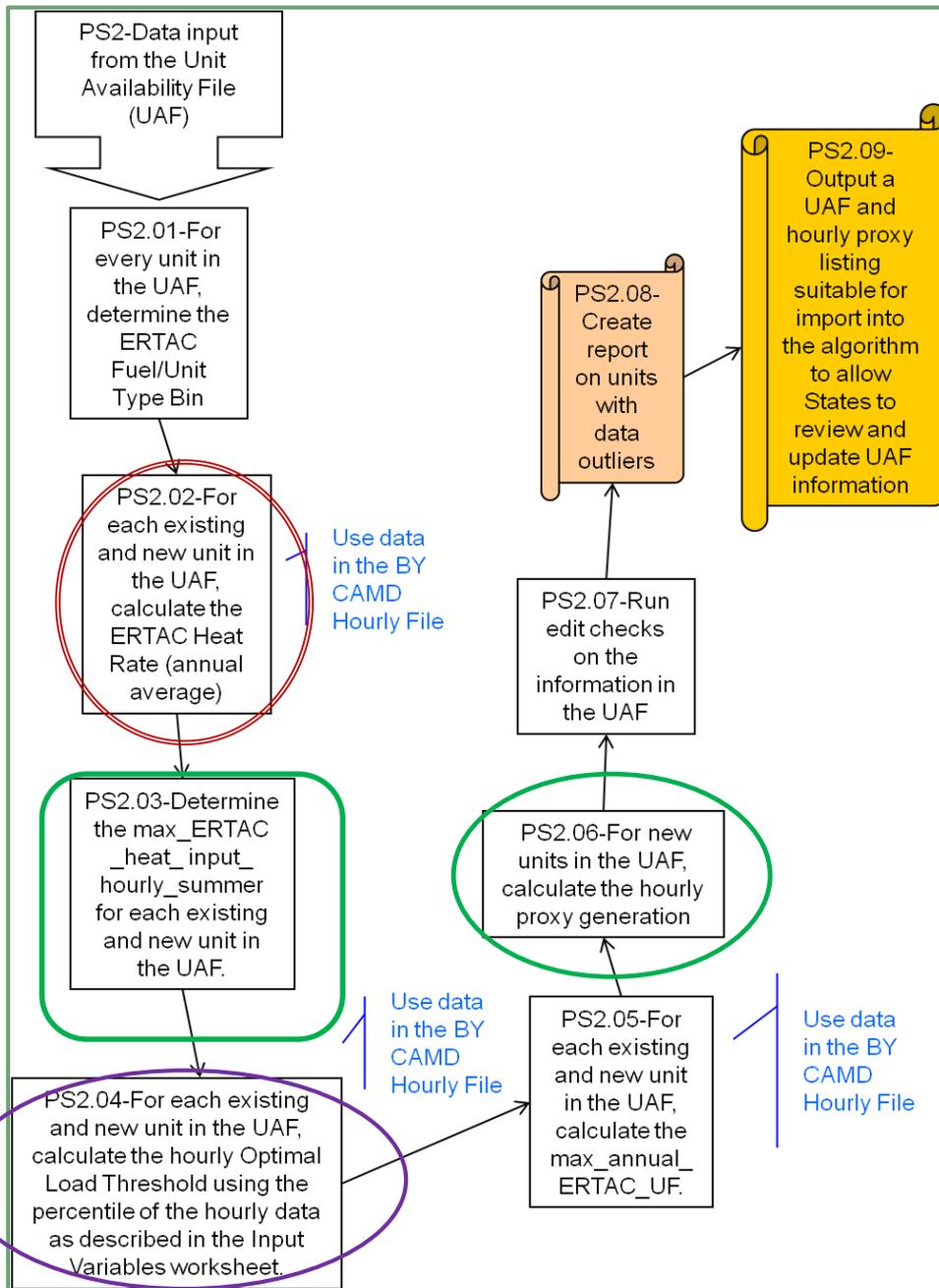
- States may choose to supply annual activity (heat input) in UAF

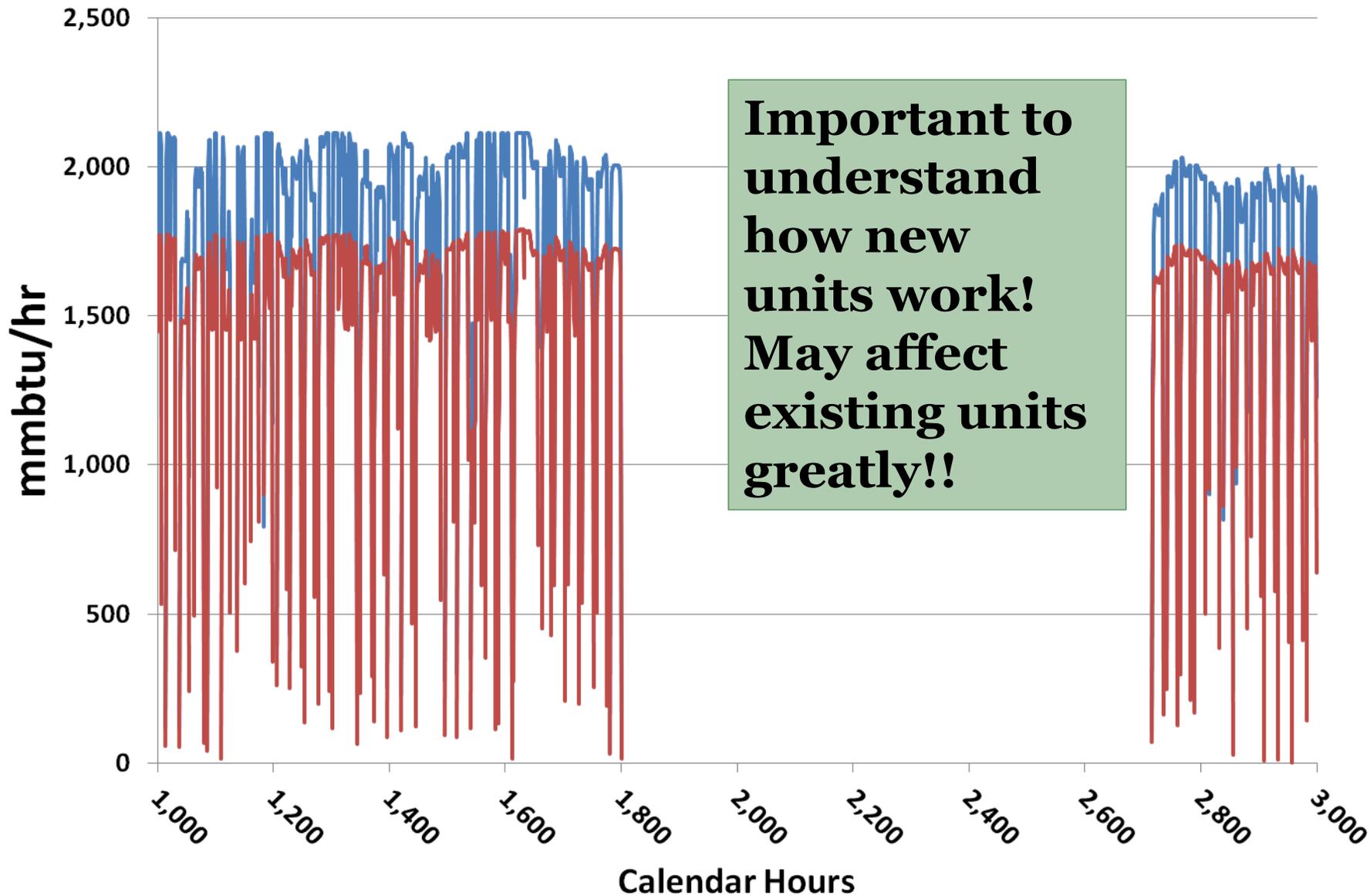


- Tool will create non-reported time period's profile, if data is supplied. Non-reported profile is flat.

# Preprocessor, part 2

- Calculates BY heat rates (may be manipulated/ updated in UAF)
- Maximum heat input
- Optimal threshold
- Begins assignment of profile to new units





— New Unit Proxy Activity for Future Year — Mimic Unit (Existing Unit)

## Preprocessor, part 3

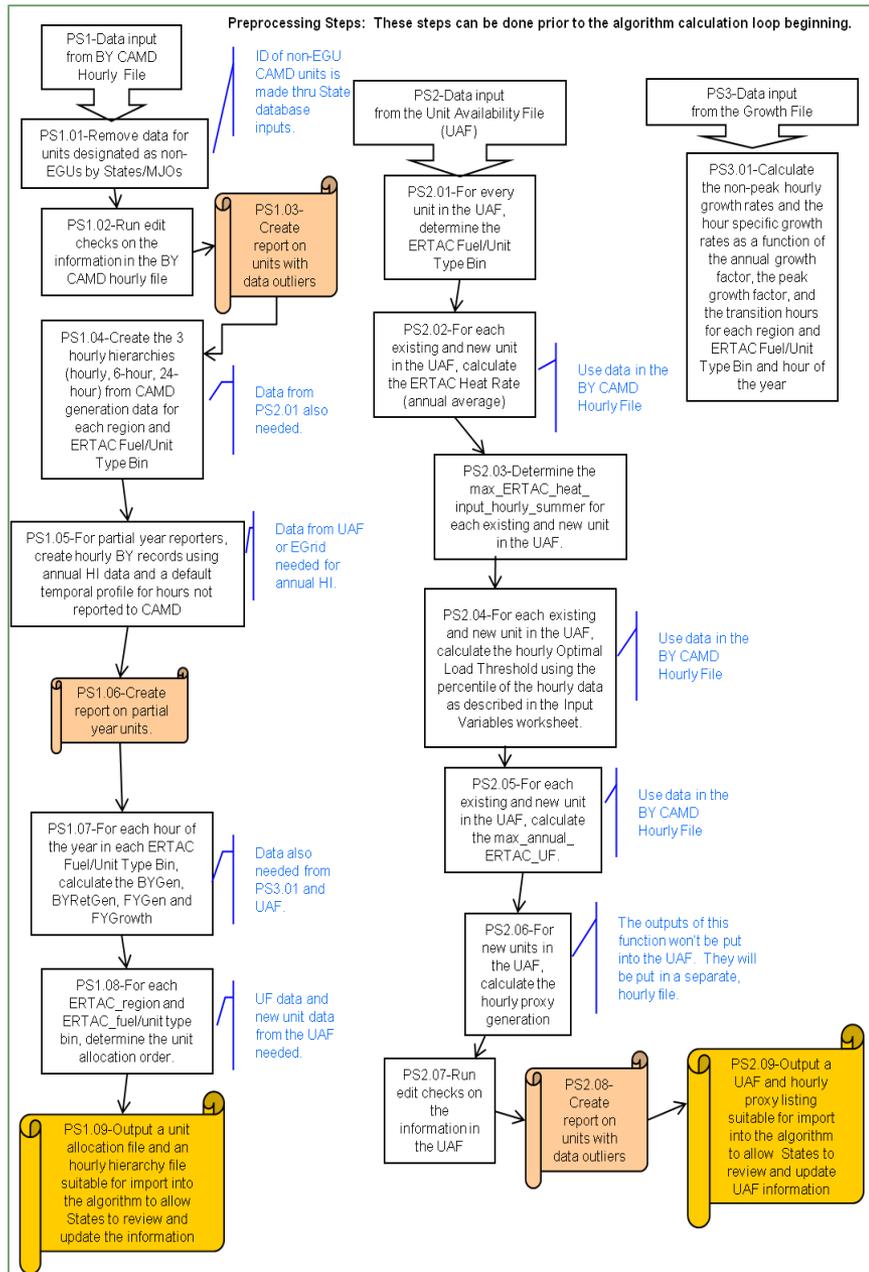
PS3-Data input  
from the Growth File

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graph TD; A[PS3-Data input from the Growth File] --> B[PS3.01-Calculate the non-peak hourly growth rates and the hour specific growth rates as a function of the annual growth factor, the peak growth factor, and the transition hours for each region and ERTAC Fuel/Unit Type Bin and hour of the year];
```

PS3.01-Calculate the non-peak hourly growth rates and the hour specific growth rates as a function of the annual growth factor, the peak growth factor, and the transition hours for each region and ERTAC Fuel/Unit Type Bin and hour of the year

- Begins calculation of the nonpeak growth rates
- Uses growth rates and transition hours provided by user

# Preprocessor Final Notes



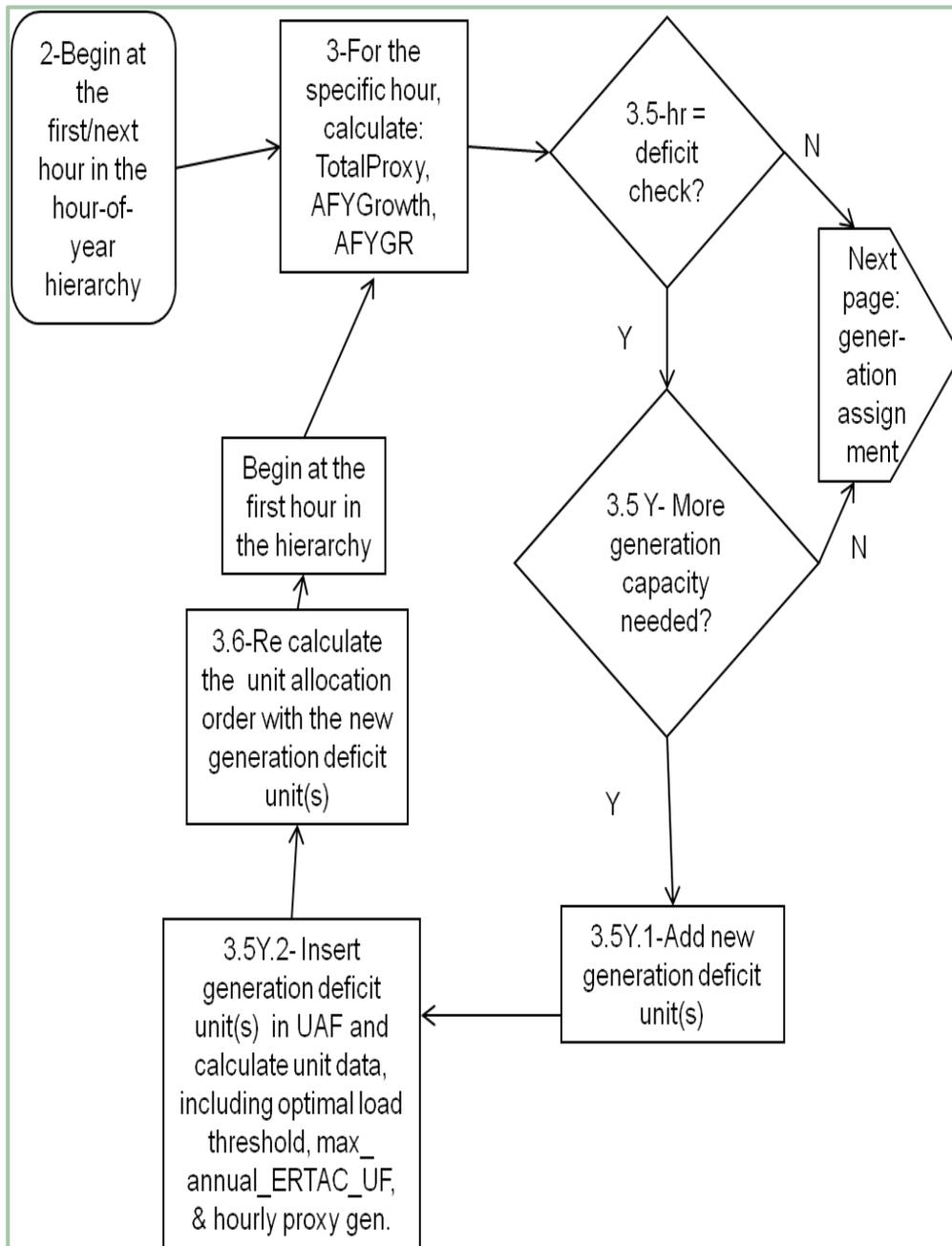
- **Creates a preprocessor log file**
  - Important for QA
  - Improves input files
  - Go through it with great care
  - We will be reviewing logs in the class! 😊
- **Files from the preprocessor are fed to the processor**

# Projection Processor



- Updated files from preprocessor fed to processor
- Capacity deficit check
  - May generate GDUs
  - GDUs treated as new units, with profiles
- Calculates future generation
  - By region and fuel/unit type
  - Outputs are modular
- Grows all existing units based on hourly growth rates
- Distributes excess generation
- Spinning reserve
- Emission calculations and cap checks

# Deficit Check



- Hour of check can be adjusted
- If worst case hourly demand or annual demand not satisfied, GDUs are created.
  - Conservative approach
  - Goal is no GDUs; State supplied new units provide all necessary power
- Necessitates additional processing
  - Updated growth rates
  - Creation of proxy profiles

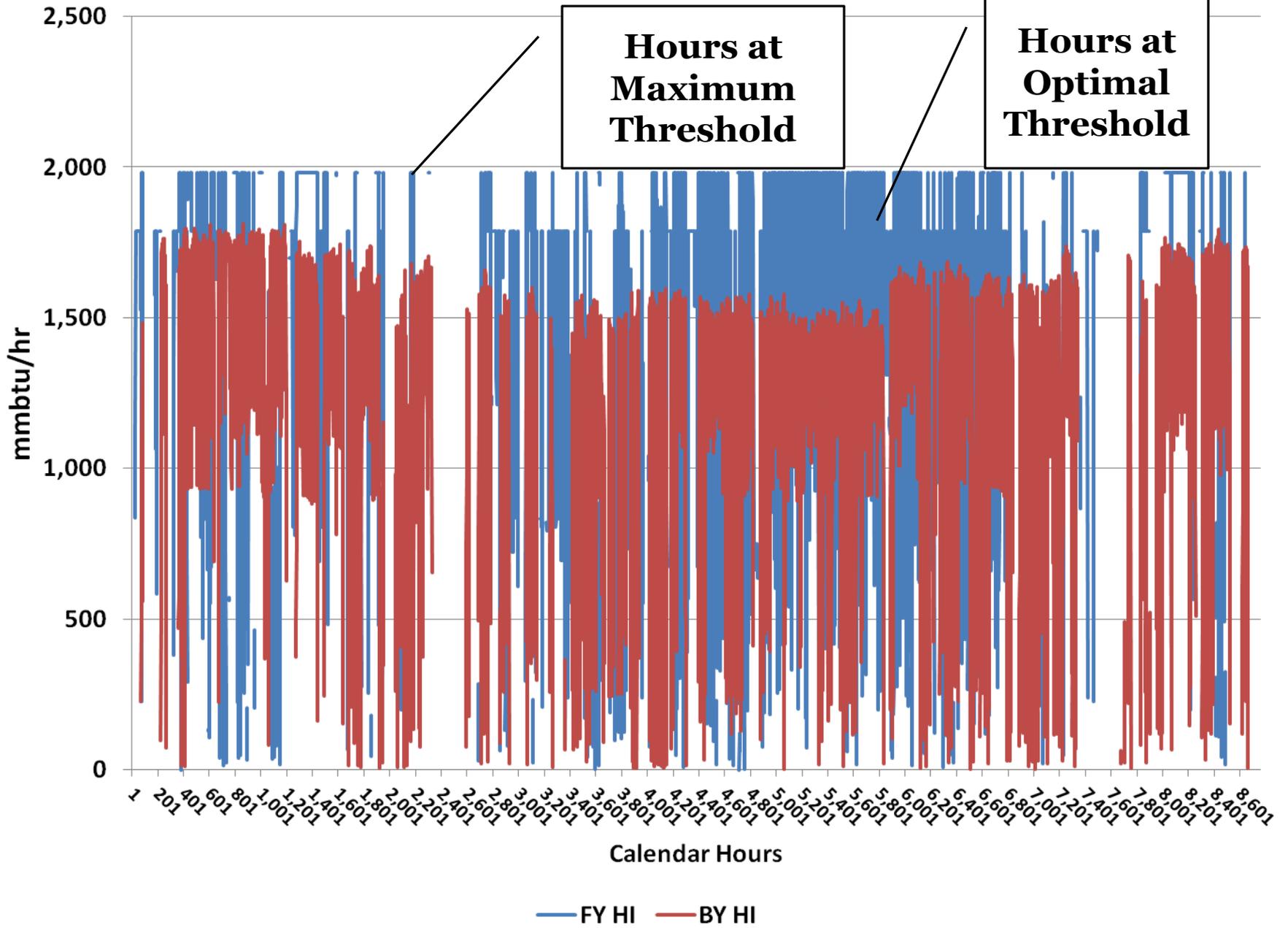
# Notes on Generation Deficit Units



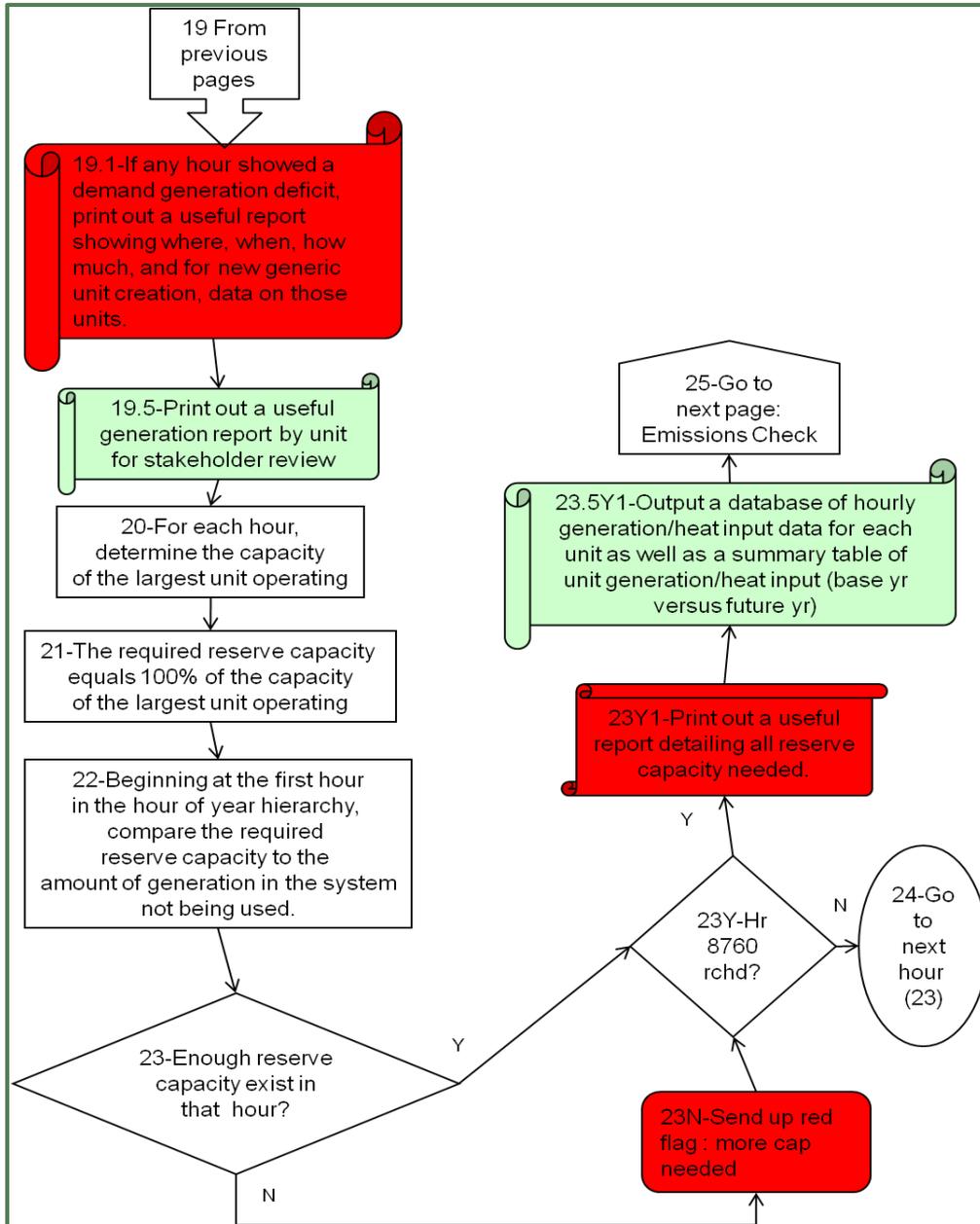
- **Conservative approach for AQ purposes**
- **# of GDUs created**
  - Min and max sizes are specified in the Input\_Variables file
  - Total capacity of GDUs based on demand in FY
  - Demand cushion option
- **Location of GDUs**
  - “Grow in Place” strategy
  - ORIS IDs may be specified in Input\_Variables file, or tool will choose based on fuel and capacity
- **GDUs = new units**
  - Proxy power
  - Recalculation of adjusted future year growth rates required
  - EFs: based on a percentile of regional emissions data, which may be specified by the user in the Input\_Variables file







# Spinning Reserve

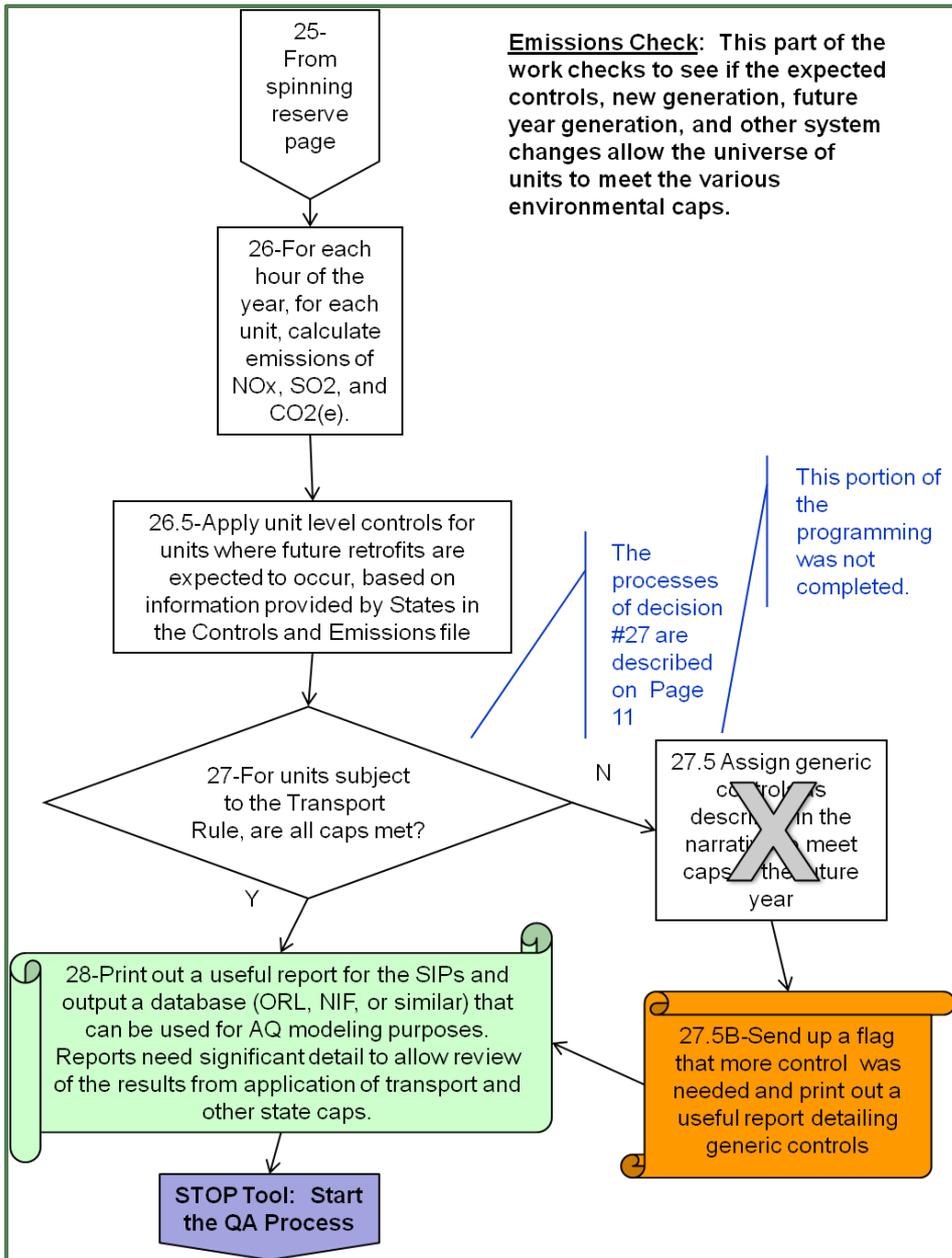


- Performed for a region after all fuel/unit types have been processed
- Spinning reserve based on 100% of capacity of largest unit operating
- Is there enough unused available capacity to cover?

# Emissions Calculations

- Emission Factors from:
  - Controls File, or
  - Average of BY data
- Compares emissions against supplied caps
- Sends up a red flag if caps are not met
- Does **not** currently assign tool-generated controls to ensure caps are met

**Emissions Check:** This part of the work checks to see if the expected controls, new generation, future year generation, and other system changes allow the universe of units to meet the various environmental caps.



# Emission Calculation Notes



- **Controls file**
  - Important data input from states
  - A lot can happen between the BY and FY
  - Take your time and review this file in depth!
- **All sorts of flexibility in controls file (see next slide)**
- **Cap comparisons: provides comparisons of FY emissions and various types of caps**
  - Tabular format
  - SO<sub>2</sub>, NO<sub>x</sub> and CO<sub>2</sub>
  - State caps examples: NC Clean Smokestacks Act, CSAPR Assurance Levels
  - Regional caps examples: CAIR Budgets, Midwestern Greenhouse Gas Initiative, RGGI

# Example NOx Control File Data

| oripl_code | unitid | factor_start_date | factor_end_date | pollutant_code | emission_rate | control_efficiency | control_programs        | control_description | submitter_email  | state | facility_name |
|------------|--------|-------------------|-----------------|----------------|---------------|--------------------|-------------------------|---------------------|--|-------|---------------|
| 703        | 1BLR   | 1/1/2017          | 4/30/2017       | NOX            | 0.176         |                    | ARP CAIRNOX,<br>CAIRSO2 |                     | <a href="mailto:albert.pearce@dnr.state.ga.us">albert.pearce@dnr.state.ga.us</a> | GA    | Bowen         |
| 703        | 1BLR   | 5/1/2017          | 9/30/2017       | NOX            | 0.056         |                    | ARP CAIRNOX,<br>CAIRSO2 |                     | <a href="mailto:albert.pearce@dnr.state.ga.us">albert.pearce@dnr.state.ga.us</a> | GA    | Bowen         |
| 703        | 1BLR   | 10/1/2017         | 12/31/2017      | NOX            | 0.176         |                    | ARP CAIRNOX,<br>CAIRSO2 |                     | <a href="mailto:albert.pearce@dnr.state.ga.us">albert.pearce@dnr.state.ga.us</a> | GA    | Bowen         |

- In the controls file comments section, GA told us to use these values for every projection year starting 2017.
- Can use the seasonal controls file to do this easily.
- Allows states to manage emissions of important units or high emitters.

# Projection Processor Notes



- FY activity is firmly grounded in BY meteorology
- Many FY estimates may be adjusted by region and fuel unit type bin in the Input\_Variables file
- NonCAMD units may be included IF:
  - Hourly BY activity data in a CAMD-like format exists
  - AEO/NERC growth rates are applicable to the unit
- Creates a **processor log file**
  - Again, review the log closely!

# What Does the Tool's Main Output Look Like?



- Hourly data
  - Heat input (mmbtu)
  - Gross load (MW-hrs)
  - NO<sub>x</sub> emissions (lbs/hr)
  - SO<sub>2</sub> emissions (lbs/hr)
  - Eventually other pollutants
- For every unit
  - New units will have no BY data, but 8,760 hrs of FY data
  - Retired units will have BY data, but 8,760 hrs of blank FY data

# What Does the Tool's Main Output Look Like?



- **Summary and informational files**
  - What hours hit max capacity?
  - What regions got GDUs?
  - What regions had spinning reserve concerns?
  - Cap comparisons
  - Unit level summaries
  - Log file
  - Updated UAF and growth files
- **Input and output files: about 16 GB**
  - 4,000-5,000 units in CONUS run
  - 8,760 hrs of data for most of them
- **Tool may be run regionally, which can decrease file sizes!**

# Post Processors

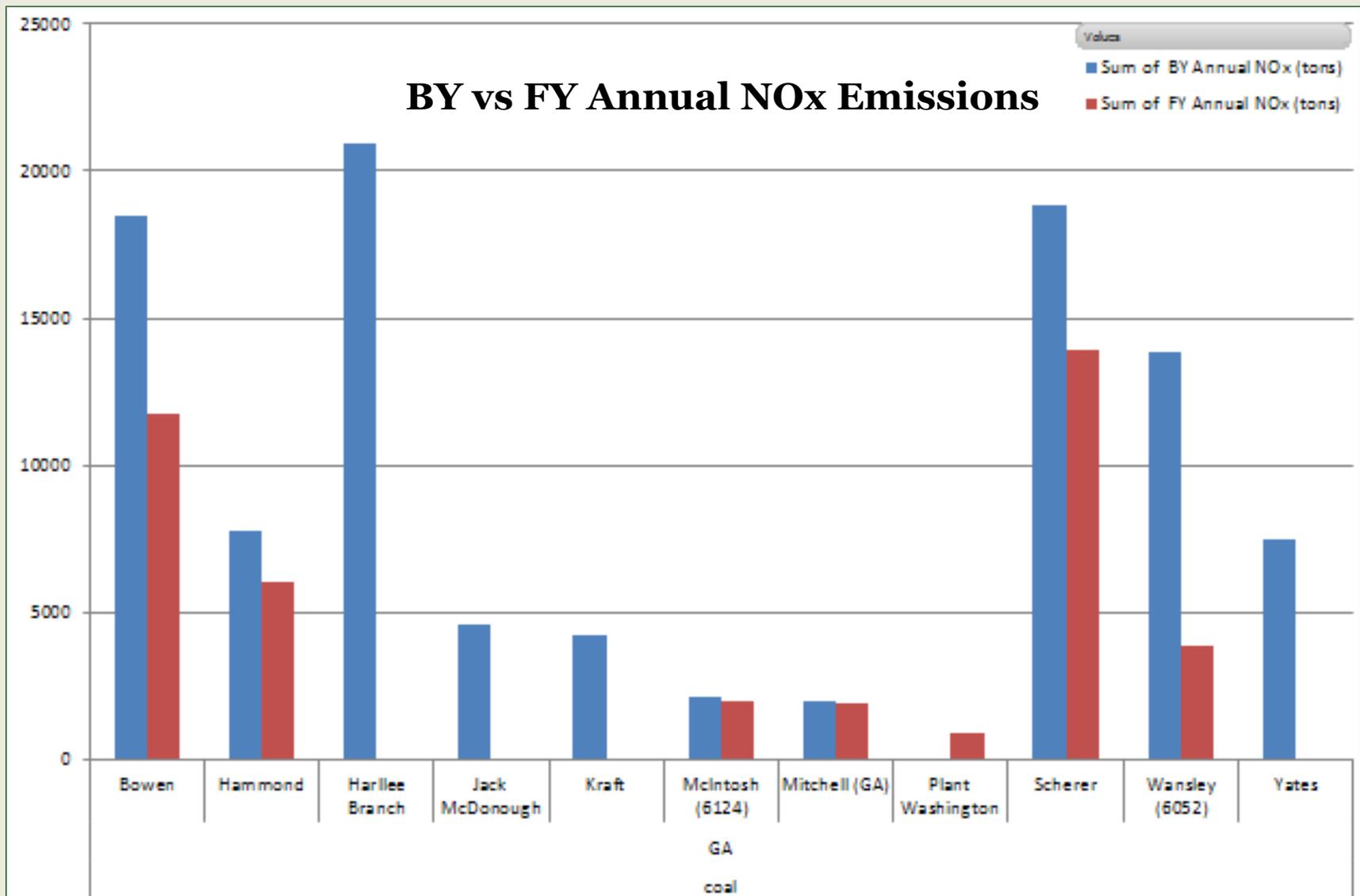


- Several have been developed
  - Enhanced Criteria Pollutant File
  - Graphical Post Processor
  - CO2 Post Processor
  - ERTAC\_to\_SMOKE
- Aids in data review and trouble shooting
- Output files are large, but can be manipulated in very interesting ways
- Tool to import data into SMOKE

# Enhanced Unit Activity File

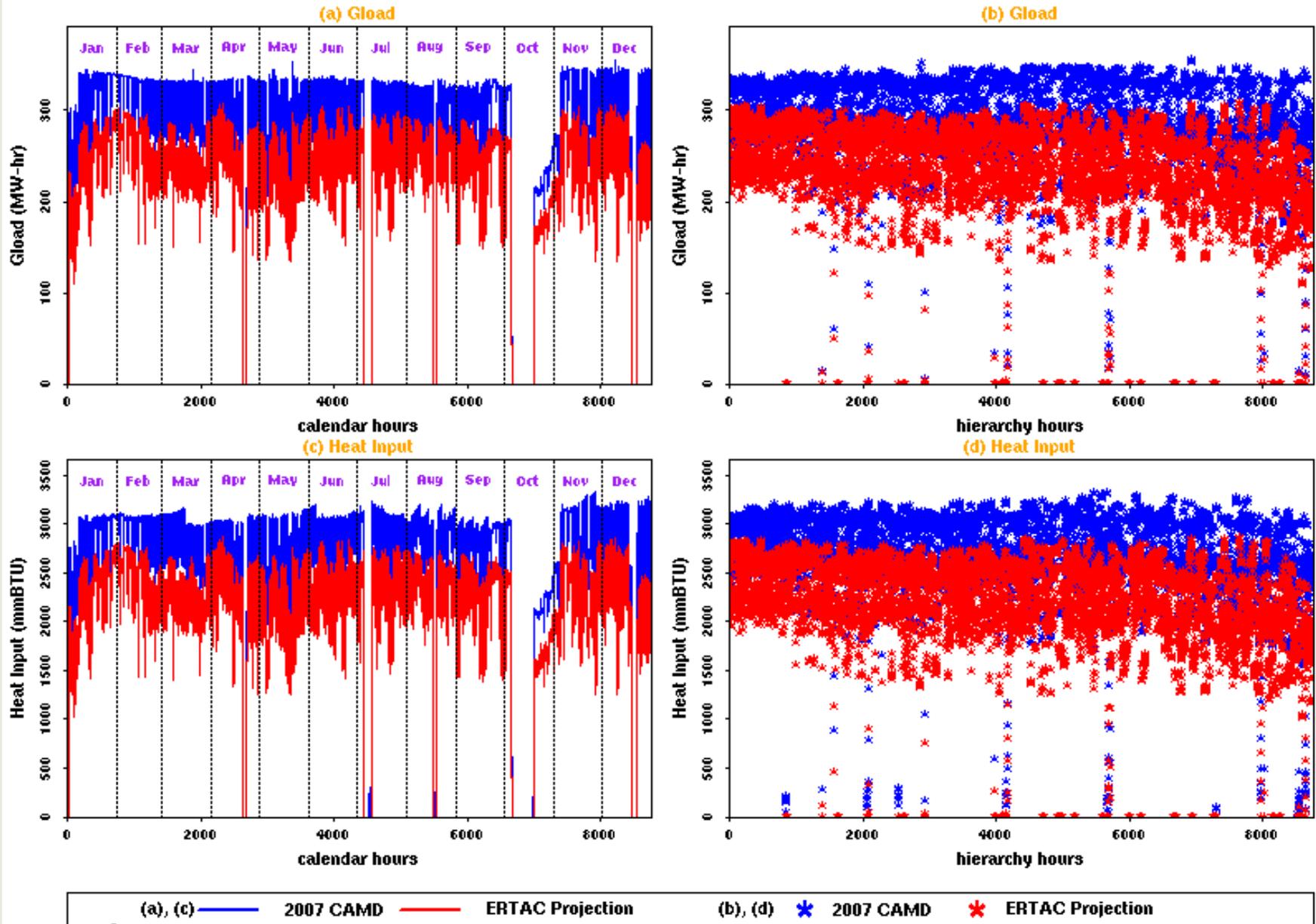
- ORIS/Unit ID
- Facility Name, State, Region
- Fuel/Unit Type
- Activity Data
  - Annually and OS
- Emissions Data
  - NO<sub>x</sub>, SO<sub>2</sub>, rates
  - Annually and OS
- Other data
  - Lat/longs
  - Retirement dates
- May be used for input and output QA
- Can be manipulated into charts and spreadsheets
- Compared with inventory estimates

# Pivot Table Options, Facility Level



# Graphical Post Processor

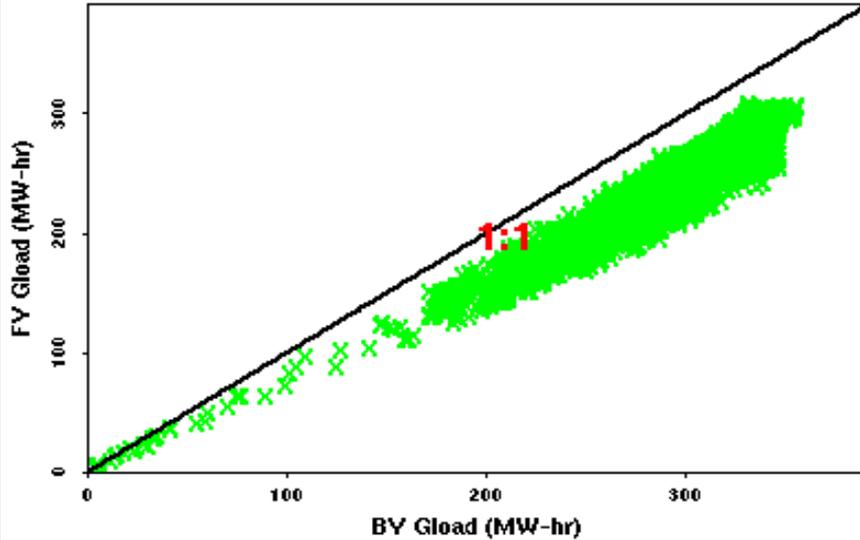
unit activities at SRVC-coal-3797-5 (page 1)



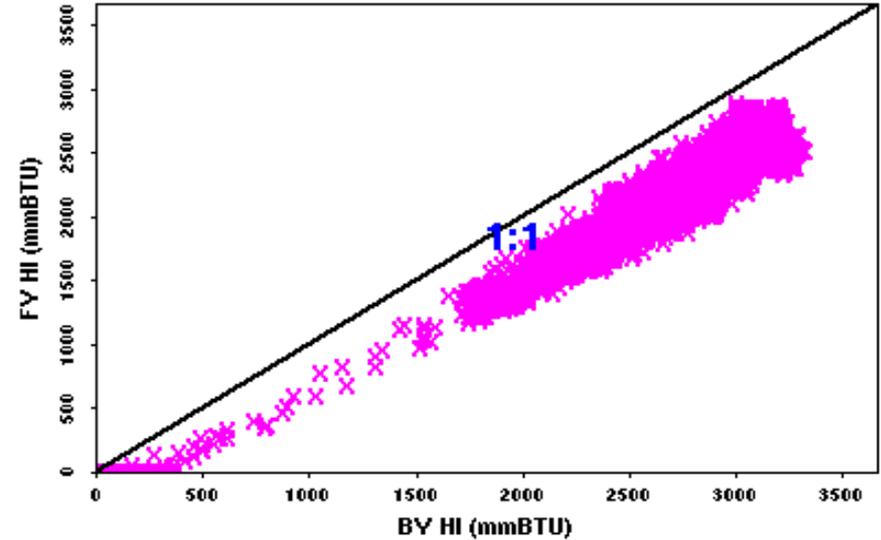
# Graphical Post Processor

unit activities at SRVC-coal-3797-5 (page 2)

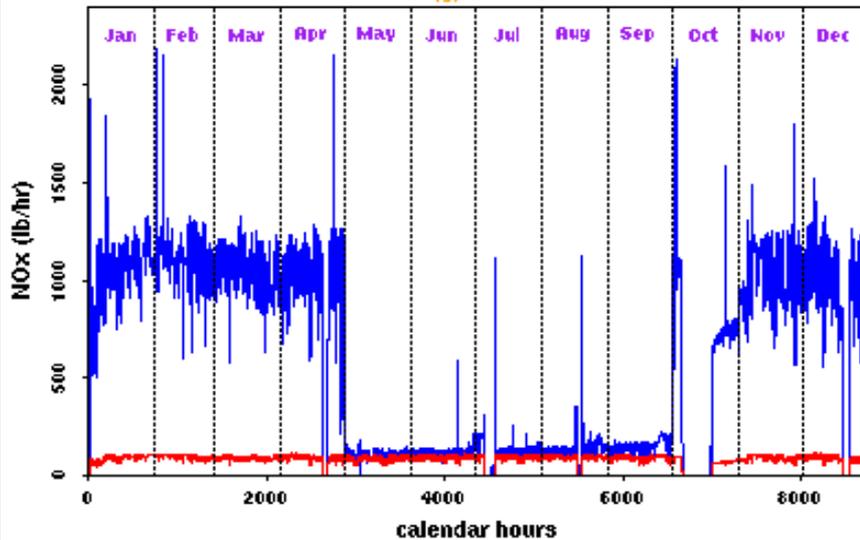
(e) Gload



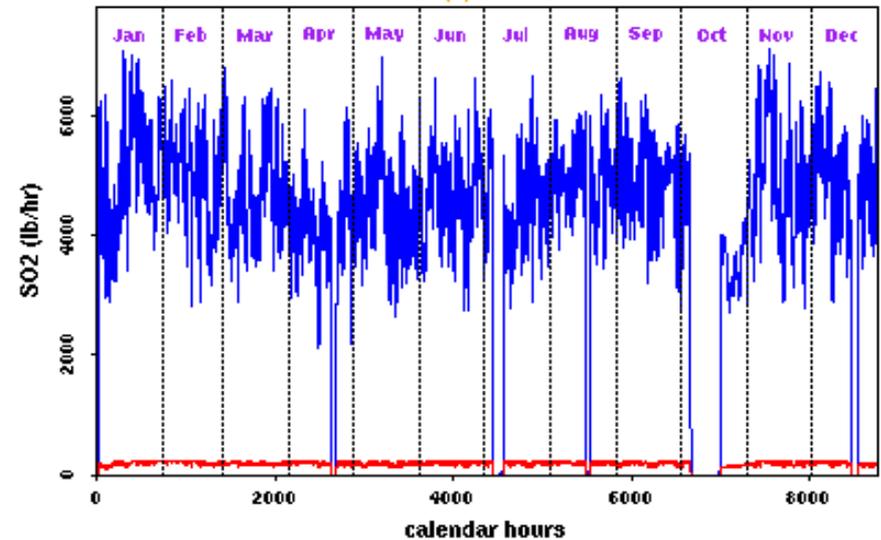
(f) Heat Input



(g) NO<sub>x</sub>



(h) SO<sub>2</sub>



(e) X Gross Load (MW-hr)

(f) X Heat Input (mmBTU)

(g), (h) — 2007 CAMD

— ERTAC Projection

# Questions?



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